Air Cushion Arrangement for a Passenger Seat

The present invention relates to an air cushion arrangement for a passenger seat, in particular for a passenger aircraft.

Passenger seats have a large number of requirements to fulfil, among which are the comfort requirements of the users. For example, with aircraft seats in the upright position the backrest must guarantee a lateral support, while in a flat or fully prone position it should provide as far as possible a flat lying surface similar to a mattress. In an intermediate position, which can be designated as a position of rest, a number of different selectable supports for the lumbar vertebral column or lumbar region is desirable.

From DE3607258A1 self-inflating cushions filled with foam material are known, which are arranged beneath the cover of an aircraft seat. These are used in the back and seat area to allow for an adaptation of the contour and thickness of the padding to the anatomical requirements of the user. No provision is made for separate adjustability of the central area and the side areas of the backrest.

From actual practice, passenger seats are known which are equipped with one or two lumbar or lumbar-dorsal cushions designed as air cushions. The aim with these cushions is to satisfy the different

requirements for comfort solely by the variation of the air volume in this cushion. This succeeds with seats in motor vehicles, the backs of which are only used in an essentially upright position. With reclining seats or sleeping seats, such as in aircraft, this is not completely achieved.

The object of the present invention is therefore to provide a passenger seat which presents more extensive adjustment possibilities.

This object is resolved by a passenger seat with the features of Claim 1.

Because the passenger seat is provided with a reclinable backrest that is provided with a cover on the front side and with a foam-filled air cushion arrangement disposed under the cover, such that the air cushion arrangement has at least one centrally located air cushion and two lateral air cushions, the contour of the backrest can be varied in the horizontal direction. Accordingly, a shell shape can be attained to provide lateral support in a generally vertical position as well as a wholly or almost flat form in a recumbent position of the backrest.

The attainment of a flat contour is further simplified if the backrest has a concave back recess arranged under the cover, which recess in the inflated state is essentially filled by the central air cushion. Preferably,

the lateral air cushions in the evacuated state are arranged essentially flat beneath the cover. In the evacuated state in particular, together with the central air cushion arranged between the lateral air cushions in the inflated state, they can form an essentially flat surface.

For a shell-shaped contour of the backrest, it is advantageous if the lateral air cushions delimit the central air cushion and in the inflated state have a lesser thickness close to the air cushion than in an area facing away from the central air cushion. Preferably, the lateral air cushions are designed in such a way that in the inflated state they continue laterally the concave shape of the back recess and the evacuated central air cushion located in it laterally in an essentially uninterrupted manner.

The subjectively pleasant impression of a fixed cover material is enhanced if the cover is secured in a detachable but pull-resistant manner at least to the lateral air cushions, and preferably also to the central air cushion, so that, when an air cushion is evacuated, the cover remains in contact with it.

Simple operation or an automatic actuation of the air cushions is made possible if the air cushions, as a function of a control arrangement, can be connected to a device for the creation of a vacuum. Provision can be made for the air cushions to be self-inflating. The air cushions, as a

function of a control unit, can be connected to a device for the generation of compressed air.

Additional comfort can be achieved by providing in the lower lumbar vertebral column region of the backrest at least one further lumbar air cushion between the central air cushion and the cover which can be inflated independently of the central air cushion. Rapid inflating and emptying of this air cushion is promoted if the lumbar air cushion is not filled with foam material.

With a method according to the invention for the adjustment of a passenger seat, in particular with a seat with the preceding features, the following steps are provided:

a) Evacuation of at least one of the air cushions centrally arranged in the backrest and inflation of at least two lateral air cushions located laterally next to the air cushion for the forming of a shell shape in an upright position of the backrest;

b) Partial inflation of the central air cushion and partial evacuation of the lateral air cushions in an inclined position of the backrest; and

c) Evacuation of the lateral air cushions and inflation of the central air cushion to form an essentially flat lying surface in a lying position of the backrest.

Provision can be made for the method steps a) to c) to be carried out by a control unit automatically as a function of the inclination angle of the backrest.

In this way, the automatic transition from a contoured backrest to a flat seat surface can be achieved.

An embodiment of the invention is described hereinafter on the basis of the drawings. These show:

Fig. 1: The air cushion arrangement in the backrest of a passenger seat according to the invention in a diagrammatic representation with the cover material removed;

Fig. 2: The backrest according to Figure 1 in the upright position with shell-shaped contour;

Fig. 3: A cross-section through the backrest according to Figure 2 along the line III-III;

Fig. 4: The backrest according to Figure 1 in a horizontal lying position with flat contour;

Fig. 5: The backrest according to Figure 4 in a cross-section along the line V-V; and

Fig. 6: The backrest according to Figure 1 in four different operating states of the lumbar cushions, which can be run through in cyclical fashion.

Figure 1 shows a backrest 1 of an aircraft passenger seat, in a diagrammatic representation. The backrest 1 has a total of four air cushions filled with foam material in the area of the lower back level, namely an upper central air cushion 2, a lower central air cushion 3, and two lateral air cushions 4. The air cushions 2-4 are partially covered on their side facing the passenger's back by two additional lumbar or lumbar-dorsal cushions 5 and 6.

For a better illustration of the position of the air cushions 2-4 relative to one another, the contours of these air cushions are represented as transparent. In a real embodiment, in the individual overlap areas the air cushions 2 and 3 are located above the lateral air cushions 4.

In addition, in a complete embodiment the backrest 1 is surrounded with a cover material and a further padding, so that the air cushions 2-6 are not identifiable.

Figure 2 shows the backrest 1 in an upright position, such as is provided for with aircraft during the takeoff and landing phases. In this position, the central air cushions 2 and 3 are largely evacuated, so that they are flat in contact with the backrest 1. The lateral air cushions 4 are inflated and in this way form a support left and right of the central area, in which the passenger's back is located.

A cross-section along the line III-III is represented in Figure 3. It can be seen that the backrest 1 has a recess 10, into which the evacuated air cushion 2 is secured. The lateral air cushions 4 in the inflated state supplement the recess 10, due to their wedge shape, to form a shell shape, which guarantees the desired seating comfort and in particular the lateral guidance.

In Figure 4, the backrest 1 is represented in a completely horizontal position, as is provided for with sleeping chairs. In this position, the lateral air cushions 4 are completely evacuated, while the central air cushions 2 and 3 are inflated. Figure 5 shows the cross-section along the line V-V in Figure 4. It can be seen that the backrest 1 has an almost horizontal flat surface due to the evacuated side air cushions 4 and the inflated central air cushion 2. In particular, the recess 10, which, with the backrest 1 upright, allows for the shell shape represented in Figure 2, is completely filled by the air cushion 2. Together with the other padding of the backrest 1 and the seat surface,

not shown, in the horizontal position an essentially flat mattress-like lying surface is therefore obtained.

Finally, Figure 6 shows the backrest 1 in four different operational states a), b), c) and d). In each case, a perspective diagrammatic representation and a side view are shown.

In Figure 6 a), irrespective of the operational state of the foam-filled air cushions 2-4, the lumbar cushions 5 and 6 are the main representation. In the operating state a) the upper lumbar cushion 5 is inflated, while the lower lumbar cushion 6 is emptied. The operational state b) shows both lumbar cushions 5 and 6 in the inflated state. The operational state c) shows the upper lumbar cushion 5 in the emptied state and the lower lumbar cushion 6 in the inflated state. Finally, Figure 6 d) shows how both lumbar cushions 5 and 6 are emptied.

In practice, the air cushion system described in this way is operated as follows. The foam-filled air cushions 2-4 cause the effect of contouring of the backrest in different inclination states. For example, when the aircraft takes off the backrest 1 is initially set upright as shown in Figure 2. The lateral air cushions 4 are inflated, while the air cushions 2 and 3 are evacuated. The shell form is derived as shown in Figure 3, which is regarded as especially comfortable due to the passenger experiencing a lateral support. If the backrest is now inclined by the

passenger, an electronic control unit causes a change to the filling state of the air cushions 2-4. The side air cushions 4 are in this situation partially emptied by being connected to a vacuum pump and as a result become somewhat flatter. The air cushions 2 and 3 are filled slightly. The contouring is on the whole drawn back as a result, a certain contouring, however, remaining. This is designated as the high position. If the backrest is inclined further, the sleeping position is finally reached. In this position, which is shown in Figure 4, the side cushions 4 are fully evacuated and therefore flat, while the air cushions 2 and 3 are inflated to the extent that they fill out the recess 10 and form a padded horizontal lying surface which is overall yielding and which is supplemented by the seat surface and the foot rest, not shown.

If the backrest is raised again after the sleeping position, the procedures described to change the degree of filling of the air cushions 2-4 are carried out in reverse order. It is preferable for the filling and evacuation procedures to be carried out automatically as a function of the inclination of the backrest 1, so that the passenger does not have any possibility of interfering in the controlling of these four air cushions.

To increase the seat comfort, the lumbar system shown in Figure 6 is provided. With this system, on the one hand, as a massage function the cycle can be selected which is shown in Figures 6 a) – 6 d). These

four operating states are run through cyclically, as a result of which the area of the passenger's lower back is massaged and manifestations of fatigue or tension states during long flights are avoided. The passenger also has the possibility of inflating the lumbar cushions 5 and 6 statically and selectively, so that the desired support of the lumbar vertebral column is achieved. This function can be undertaken independently of the control of the air cushions 1-4, since the lumbar cushions 5 and 6, in a preferred embodiment, are not filled with foamed material and filling and emptying can therefore be carried out relatively quickly, while with the foam-filled air cushions 2-4 the evacuation and filling procedure takes place relatively slowly.

Finally, provision is made with the air cushions described for the cover arranged over them to be connected in a pull-resistant but detachable manner to the cushions 2-4, for example by means of a self-adhering strip (Velcro strip). This connection leads to the situation that, on the evacuation of the air cushions 2-4, the cover material follows the air cushion. This prevents the cover material from being arranged in an undefined manner when the air cushion is evacuated.